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PRELIMINARY RESULTS OF MEASUREMENTS OF THE INTENSITY OF THE DISTRIBUTED COSMIC RADIO EMISSION IN THE 725 AND 1525 KC FREQUENCIES ON THE SATELLITE " ELECTRON - 2"

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PRELIMINARY RESULTS OF MEASUREMENTS OF THE INTENSITY OF THE DISTRIBUTED COSMIC RADIO EMISSION IN THE 725 AND 1525 KC FREQUENCIES ON THE SATELLITE "E L E C T R O N - 2"

(*)

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S U M M A R Y

The measured intensity of the cosmic radio emission distributed in the frequencies of 725 and 1525 kc/s was found to be respectively equal to $0.51 \cdot 10^{-20}$ and $0.87 \cdot 10^{-20}$ watt m^{-2} cps^{-1} $sterad^{-1}$. At satellite distances from Earth up to 68 000 km radio emission was observed, which probably cannot be explained fully by interferences of terrestrial origin, "seeping" through the ionosphere.

* • *

The frequency spectrum of cosmic radio emission was measured more than once, but, to-date, it still has not been determined in a sufficiently broad interval with an accuracy indispensable for theoretical conclusions. The latter is the more so related to the high-frequency and low-frequency portions of the spectrum, which are of interest for the theory of origin of cosmic radio emission and electron component of primary cosmic rays [1]. The main difficulty in measuring the spectrum in the ultrahigh frequency range is linked with the very low level of cosmic radio emission and with the requirement in this regard to utilize apparatus with the smallest possible fluctuational threshold response. As to the measurements in sufficiently low frequencies ($f < 3 \div 5$ Mc/s), they may be carried out without

(*) PREDVARITEL'NYYE REZUL'TATY IZMERENIYA INTENSIVNOSTI RASPREDELENNOGO KOSMICHESKOGO RADIOIZLUCHENIYA NA CHASTOTAKH 725 and 1525 KGZ NA SPUTNIKE "ELEKTRON-2".

substantial distortions from the side of the ionosphere only on sufficiently high artificial satellites and rockets. So far only a few attempts were made for measuring the intensity spectrum of cosmic radio emission in sufficiently low frequencies with the aid of apparatus installed aboard satellites and rockets (the review of the results obtained has been presented in [2]). Because of their small number, the correeponding data require checking and must be made more precise. With this in view the investigations here described were conducted aboard radioreceivers installed aboard "Electron-2" in the frequencies of 725 and 1525 kc/sec.

1. APPARATUS AND METHOD OF MEASUREMENTS

The block-diagram of the receiving apparatus is presented in Fig. 1

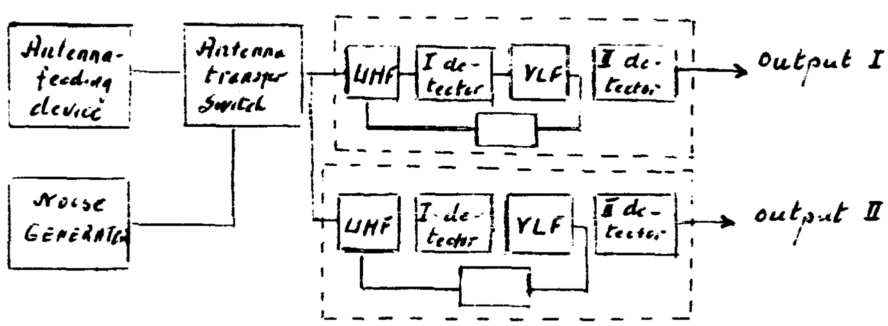

Fig. 1. - Block-diagram of the receiving installation

The reception of radic emission is materialized by means of a collapsible-whip antenna of ~ 4 m length. From antenna output the voltage is fed simultaneously to two receivers, respectively tuned to the frquencies of 725 and 1525 kc.sec. Decoupling filters were used in order to avoid mutual shunting influence of high-frequency circuits of radio receivers.

The vacuum-tube receivers are assembled by direct amplification circuit with three amplification cascades in high and two in low frequency. The constant voltages from radioreceiver outputs, proportional to field intensity of measured signals, are fed to telesystem. A special system of automatic regulation of amplification is foreseen in receivers, which widens considerably the range of measured field intensities. The receiver passband widths in high frequency are equal to 3.9 kc/s in the 725 kc frequency and 7.4 kc/s in the 1525 kc/s frequency. The time constants of receiver output circuits are near 1 second. The equivalent noise voltages, fed to receiver inputs are approximately identical in both frequencies and equal to 0.4 mkv. The receiver feed is materialized from voltage transformers assembled on semiconductors.

In the operational regime the switching on of radio receivers and the count of received signal level is carried out during a short time interval, every two minutes. Once in the course of one hour the noise voltage generator, assembled on a semiconductor triode, is switched on to receiver inputs with the help of an autonomous antenna transfer switch. The control of radioreceivers' amplification is materialized with the aid of the noise generator.

2. - RESULTS OF MEASUREMENTS

We plotted in Fig. 2 a portion of the registration of cosmic radio emission for the time, when "Electron-2" was near apogee (near 68 000 km). The dashed circles emphasize the calibration points responding to signals periodically switched to noise generator's receivers. In ordinates we plotted the values of voltages at receivers' input in microvolts and the value of the effective temperature of the sky, computed according to them, taking into account the resistance of antenna radiation. As may be seen from Fig. 2, the levels of radio emission vary somewhat in time, which in all probability must be linked with satellite spinning and the shifting of receiving antenna's radiation pattern along the sky.

The absolute values of effective temperatures of the sky in the frequencies of 725 and 1525 kc/s are respectively equal to $3.2 \cdot 10^7$ and $1.2 \quad 10^7 \ {}^\circ K$, that is T_{eff} rises as the frequency descends according to the law $T_{eff} \propto \nu^{-1,3}$ while the intensity of radio emission $I_\nu = 2kT_{eff} \cdot \nu^2 / c^2 \infty \nu^{0.7}$ decreases as the frequency diminishes *

* The error in the values of sky's absolute effective temperatures brought up is mainly linked with the inaccurate knowledge of resistance of antenna radiation and constitutes $\pm 30\%$. The error in the determination of the ratio $T_{eff}(725) / T_{eff}(1525) = 2.7$ is $\pm 15\%$ and is linked with calibration errors.

Significant fluctuations are noted, as a rule, in readings for radio emission levels in both frequencies for the portions of satellite orbit corresponding to distances from Earth < 20 000 – 30 000 km. Their presence may be partly explained by interferences of terrestrial origin "seeping" through the ionosphere. The question as to whether or not these radio emission level fluctuations can be entirely ascribed to interferences of terrestrial origin still remains open and requires additional consideration (see annotation at correction at the end of the paper).

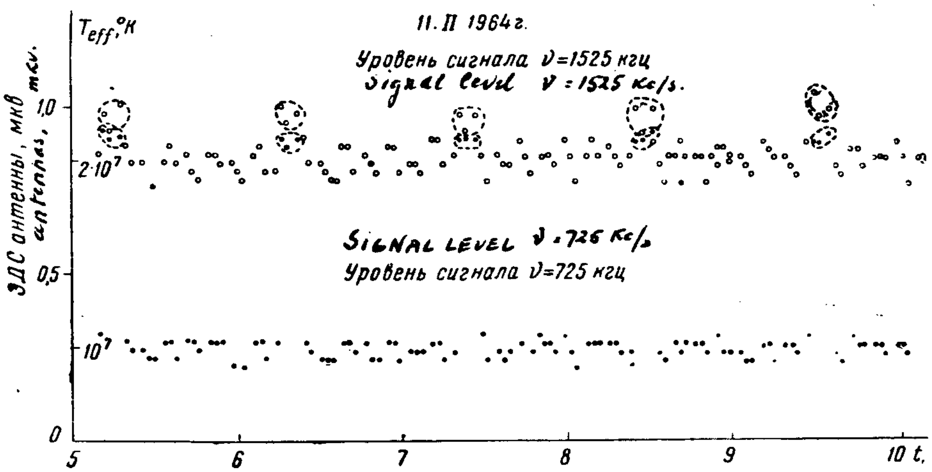

Fig. 2. - Registration of levels of cosmic radiation.

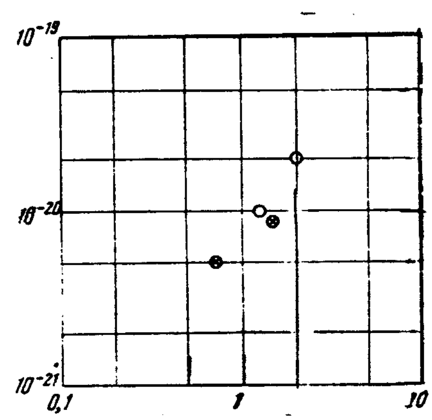

Fig. 3. - Results of measurements of cosmic radiation intensity.

Circles – data from [3]
Circles with cross – data obtained from "Electron-2"

3. - COMPARISON OF THE RESULTS OBTAINED WITH AVAILABLE DATA

The experimental values of the effective sky temperature in the frequencies of 725 and 1525 kc/s are plotted in Fig. 3 alongside with the values of T_{eff} in the frequencies of 1.25 and 2 Mc/s, found from data of rocket measurements [2]. The ratio $T_{eff}(725)/T_{eff}(1525) \approx 2.7$, that is, somewhat greater than that following from the data of [2]. It may be seen from Fig. 3 that in the frequencies of the order 1 ÷ 2 Mc the effective temperature of the sky continues to rise with frequency decrease, while the radio emission intensity linked with T_{eff} by the Rayleigh-Jeans law drops as the frequency decreases.

The fact of cosmic radio emission intensity drop at low frequencies according to the law $I \propto \nu^{0,7}$ may, in principle, be explained by its absorption in the interstellar ionized gas [1, 3]. At the same time, it is quite possible that the drop in the intensity of cosmic radio emission in low frequencies as the frequency decreases is determined, at least partly, by the peculiarities of the frequency spectrum of extragalactic sources of cosmic radio emission, whose contribution to the observed radio emission may be significant.

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*** THE END ***

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ADDENDUM

Annotations at Correction.

1. - Subsequent analysis of experimental data has shown that the observed increased radio emission correlates closely with the presence in radiation belts of fluxes of relatively soft charged particles. The radio emission maximum corresponds to geomagnetic latitudes $\pm(40-50)^{\circ}$, and it is practically absent at geomagnetic equator. The increased radio emission is, in all probability, generated by fluxes of charged particles in the upper ionosphere. Detailed data on increased radio emission will be published in [4]. -

2. - At further analysis T_{eff} were made more precise. In this connection we must correct in Fig. 2 the values in ordinates :

$1.2 \cdot 10^7$ should replace $2 \cdot 10^7$,

and

$3.2 \cdot 10^7$ should replace — 10^7.

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